Healthcare ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Healthcare

journal homepage: www.elsevier.com/locate/hjdsi

Using active choice within the electronic health record to increase physician ordering and patient completion of high-value cancer screening tests

Mitesh S. Patel [a,b,c,d,e,*], Kevin G. Volpp [a,b,c,d,e], Dylan S. Small [b], Craig Wynn [a], Jingsan Zhu [a,d], Lin Yang [a], Steven Honeywell Jr.[a], Susan C. Day [a]

[a] Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, United States
[b] The Wharton School, University of Pennsylvania, Philadelphia, PA, United States
[c] Crescenz Veterans Affairs Medical Center, Philadelphia, PA, United States
[d] Center for Health Incentives and Behavioral Economics, Leonard Davis Institute of Health Economics, University of Pennsylvania, Philadelphia, PA, United States
[e] Penn Medicine Center for Health Care Innovation, University of Pennsylvania Health System, Philadelphia, PA, United States

ARTICLE INFO

Article history:
Received 12 March 2016
Received in revised form
25 April 2016
Accepted 26 April 2016

Keywords:
Active choice
Choice architecture
Physician behavior
Behavioral economics
Electronic health record
Cancer screening
Colonoscopy
Mammography

ABSTRACT

Background: High value screening tests such as colonoscopy and mammography can improve early cancer detection but are often underutilized.
Methods: We evaluated an active choice intervention using the electronic health record (EHR) to confirm patient eligibility for colonoscopy or mammography during the patient's clinic visit and prompt the physician and his/her medical assistant to actively choose to "accept" or "cancel" an order for it. We fit multivariate logistic regression models using a difference-in-differences approach to evaluate changes in physician ordering and patient completion of colonoscopy and mammography at the intervention practice compared to two control practices, adjusting for time trends, patient and clinic visit characteristics.
Results: The sample comprised 7560 patients due for colonoscopy and 8337 patients due for mammography. Pre-intervention trends between practices did not differ. In the adjusted models, compared to the control group over time, the intervention practice had a significant increase in ordering of colonoscopy (11.8% points, 95% CI: 8.0–15.6, $P<0.001$) and mammography (12.4% points, 95% CI: 8.7–16.2, $P<0.001$). There was a significant increase in patient completion of colonoscopy (3.5% points, 95% CI: 1.1–5.9, $P<0.01$), but no change in mammography (2.2% points, 95% CI: −1.0 to 5.5, $P=0.18$).
Conclusions: Active choice through the EHR was associated with an increase in physician ordering of colonoscopy and mammography. The intervention was also associated with an increase in patient completion of colonoscopy but no change in patient completion of mammography.
Published by Elsevier Inc.

1. Introduction

Cancer is a leading cause of mortality in the United States, accounting for about one in four deaths each year.[1] High value screening tests can improve early cancer detection.[1,2] However, these tests are often underutilized,[1–6] and there is a significant need for new approaches to address this issue.

Well-designed clinical decision support within the EHR has been demonstrated to improve clinician performance across many process measures, but there has been less evidence evaluating their impact on patient outcomes.[7–10] Recently, there has been growing interest in using insights from the behavioral sciences to design choices within the EHR to impact patient care.[11–13] For example, our prior work demonstrated that changing prescription order entry defaults could be used to increase generic medication utilization.[14]

Active choice is a method that has been demonstrated to change behavior by providing an opportunity for a decision between options to be made before one can proceed to the next step in the process.[15] In these contexts, the decision-maker is prompted at the appropriate time (e.g. when the patient is there for a clinic visit) using an 'interrupted alert', information can be provided to highlight the desirable features of the option preferred by the choice architect (e.g. your patient is due for this high value screening test), and the choice can be made mandatory ('forced choice') so the respondent has to make a decision before proceeding with the visit or to the next stage of the decision-making process. Active choice has been shown to increase patients' renewal of prescription medications and intent to obtain an

* Correspondence to: 423 Guardian Dr., 1312b Blockley Hall, Philadelphia, PA 19104, United States.
E-mail address: mpatel@upenn.edu (M.S. Patel).

http://dx.doi.org/10.1016/j.hjdsi.2016.04.005
2213-0764/Published by Elsevier Inc.

influenza vaccination.[15] However, the application of active choice within healthcare is limited and the impact on both physician and patient behavior has not been well evaluated. The objective of this study was to evaluate the association of an active choice intervention with changes in physician ordering and patient completion of colonoscopy and mammography, two high-value cancer screening tests.

2. Methods

This study was approved by the University of Pennsylvania institutional review board. Informed consent was waived because it was not possible given the retrospective study design and the study posed minimal risk to patients.

2.1. Study sample

The sample comprised patients with a clinic visit at one of three internal medicine practices at the University of Pennsylvania Health System between February 15, 2011 and February 14, 2013 (one year before and after the intervention start date). All three sites were academic teaching practices with faculty and residents located within proximity (0.3 miles apart) in Philadelphia, Pennsylvania.

The sample of patients eligible for colon cancer screening were age 50–74 years. To ensure we evaluated a sample of patients that were due for a screening colonoscopy, we excluded patients with any of the following: (1) colonoscopy procedure completed within 10 years of the clinic visit based on health system insurance claims; (2) electronic medical record noted the patient was up to date on colon cancer screening (using health maintenance data from EPIC, the outpatient electronic medical record); (3) fecal occult blood test (FOBT) or fecal immunochemical test (FIT) completed within one year of clinic date; (4) history of colon or rectal cancer, inflammatory bowel disease, any type of colitis, or gastrointestinal bleeding (Supplement).

The sample of patients eligible for breast cancer screening by mammography were females age 50–69 years. To ensure we evaluated a sample of patients that were due for a screening mammography, we excluded patents with any of the following: (1) mammography completed within one year of the clinic visit based on health system insurance claims (at the time of the intervention national guidelines recommended annual mammography screening); (2) electronic medical record noted the patient was up to date on breast cancer screening (using health maintenance data from EPIC); (3) history of breast cancer, breast mass, or breast surgery (Supplement).

2.2. Intervention

Prior to the intervention, providers at all three clinics had to manually check if a patient was due for a colonoscopy or mammography and then place an order for the test. On February 15, 2012 one of the clinics implemented a change to the electronic health record settings by using a best practice alert in EPIC. This intervention confirmed patient eligibility for the test during the clinic visit and upon signing into the electronic health record for that patient prompted the provider to actively choose to “accept” or “cancel” an order for a colonoscopy, mammography, or both. This alert was delivered to physicians (who could place and sign orders) and their medical assistants (who could place orders for the physician to sign).

2.3. Main outcome measures

The primary outcome measures were the percentage of patients eligible for colon cancer screening that had a colonoscopy ordered by the physician and the percentage of patients eligible for breast cancer screening that had a mammography ordered by the physician. The secondary outcome measures were the percentage of patients eligible that completed colonoscopy and mammography. To identify a reasonable period of time that a completed test could be attributed to the visit, we used a prior sample of patients who completed each test and estimated the time within one year one after the visit for which about 80% of tests were completed. Based on this data, we classified colonoscopy completion as within six months of the visit and mammography completion as within three months of the visit.

2.4. Data

Clarity, an EPIC reporting database, was used to obtain data on patient demographics and comorbidities, clinic visits including type of visits and status of provider as primary care physician or not, and test orders for colonoscopy and mammography. Health insurance claims were obtained from the billing system at University of Pennsylvania Health System. Data on Medicare or Medicaid insurance were missing for some patients during the pre-intervention year because the method by which the health system captured this data changed. These patients were coded as having other insurance.

2.5. Statistical analysis

Unadjusted analyses were performed to evaluate test order and completion rates over time. Given the monthly fluctuation due to sample size, these data are presented at the quarterly level.

We used multiple time series research design,[16,17] also known as difference-in-differences, to compare within-practice pre- and post-intervention outcomes between the intervention practice and the two control practices. While some opportunity for residual confounding remains, this approach reduces potential biases from unmeasured variables from three possible sources.[17–19] First, a difference between groups that is stable over time cannot be mistaken for an effect of the intervention because practice site fixed effects are used to compare each practice with itself before and after the intervention. Second, changes affecting both groups similarly over time, such as technological improvements or pay-for-performance initiatives, cannot be mistaken for an effect because the regression models use monthly time fixed effects. Third, if the patient mix is changing differently among practices, and if these changes are accurately reflected in the measured risk factors, this cannot be mistaken for an effect of the intervention because the regression models adjust for these measured risk factors.

Similar to prior work,[14,20,21] a multivariate logistic regression model was fit to the binary outcome measures (test ordered or test completed) using the patient as the unit of analysis and adjusting for demographics (age, gender, race/ethnicity), comorbidities (using the Charlson Comorbidity Index which predicts 10-year mortality),[22] insurance type, whether the visit was with the primary care provider or not, and visit type (new, return, reassign provider, other). The model compared the post-intervention year (February 15, 2012 to February 14, 2013) to the pre-intervention year (Feb 15, 2011 to Feb 14, 2012), adjusting for calendar month (one term for each month of the year) and practice site fixed effects. Standard errors in the models were adjusted to account for clustering by patient.[23,24] To assess the mean effect of the intervention in the post-intervention period, we exponentiated the mean of the monthly interaction term log odds ratios for the

Please cite this article as: Patel MS, et al. Using active choice within the electronic health record to increase physician ordering and patient completion of high-value cancer screening tests. *Healthcare* (2016), http://dx.doi.org/10.1016/j.hjdsi.2016.04.005